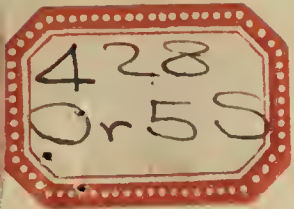


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SOME OBSERVATIONS

ON THE

CESTRIDÆ,

COMMONLY KNOWN AS "BOT FLIES

ESPECIALLY ON THE

OX WARBLE FLY.

BY

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OBSERVATIONS ON THE
ÆSTRIDÆ,
COMMONLY KNOWN AS "BOT FLIES."

THE following Lecture on some of the points by which the family of Flies, popularly known as Bot Flies, may be distinguished from other insect-pests infesting cattle or horses, together with notes on the habits of the Common Horse Bot Fly and Ox Warble Fly, was delivered by Miss E. A. ORMEROD on June 20th to the Students of the Royal Agricultural College, Cirencester.

In the observations which I have hitherto had the pleasure of offering to you, on our insect farm pests, I have only alluded to those which are injurious to field crops, or (speaking generally) to plant-life. But in the course of the last few years, still more in the course of the last few months, the amount of injury noticed as occurring to common farm stock from attacks of various common kinds of Flies or their maggots shows a need of so much more inquiry into both their history and also practicable means of prevention, that I venture to offer a few notes on a portion of the subject, hoping that by bringing it forward we may gain contributions of further information.

Amongst the worst kinds of these attacks we find three distinct sorts, namely, those of the Gad Flies, which suck the blood; those of the Bot Flies, which live in their maggot-state in some part of the attacked animal; and those of the Flesh Flies, which (also in their maggot-state) will fairly devour the living flesh down to the bone.

I purpose to-day to speak to you more especially of the family of the "Bot Flies," and, amongst these, of the "Ox Bot Fly" or "Warble Fly," as I think, for the sake of distinction, it might more conveniently be called, and, by taking the main points in its life-history, I hope to show how much lies in our power towards checking its ravages. On this matter I have some slight personal knowledge, and also the advantage of communication with correspondents well acquainted with the subject; but, as this attack has hitherto not been so much observed popularly as that of the common Horse Bot Fly, I will give a short account of this also to show how the habits of these two Flies (save in immediate connection with the animals they attack) may in many points fall under the same kind of measures of prevention. In these histories I quote largely, regarding the Horse Bot Fly, from the treatise of Bracy Clark, which is still our chief English authority on the subject, and, regarding the Warble Fly, from the same treatise, and from the more recent and exceedingly elaborate treatises of Friedrich Brauer.

But before beginning the consideration I will just remark that such boundless confusion and really serious difficulty in understanding this subject has arisen from the indiscriminate use of the names of Gad Fly, Bot Fly, Breeze Fly, and other appellations, that it will be well first of all to attend to this matter that we may be sure what we are speaking about.

The "Gad Flies," properly so called, have *nothing at all* to do with raising warbles on the backs of cattle, or causing deposit of maggots inside farm stock, whether in their nostrils, or stomachs, or elsewhere. They only do

harm in their *Fly*-state as *blood-suckers*. The proboscis encloses an apparatus of sharp lancet-like points, with which the female pierces the skin and draws away the blood of the attacked animals ; and here yon have a



Ox Gad Fly, *Tabanus bovinus*, and side view, with lancets extended.

good reason for keeping the name of “Gad Fly” solely to this family ; its mouth is filled with a packet of most effective *gads* or *goads*, which distinguish it clearly if seen, and if not seen, may be often known of by the blood flowing from the puncture on the animal.

Further, the Gad Fly maggots live, as far as we know, in the ground or decaying vegetables, *not* in animals.

In the case of the Ox Gad Fly, *Tabanus bovinus*, as observed by DeGeer, the grubs or maggots are long, worm-like, narrowest at each end, footless, but having a distinct head, and the chrysalis is somewhat in shape like the maggot much shortened, and showing the shape of the coming wings. As I have not a figure of these conditions I give a very similar set of transformations from the figure by Prof. Riley, of those of the great

Black American Gad Fly, the *Tabanus atratus*. This family is scientifically known as *Tabanidæ*.



Tabanus atratus, larva and pupa; after Riley.

The family of the true Bot Flies, or *Æstridæ*, on some of which I am about to speak to you, are easily distinguishable from the above. The perfect Flies, with a few exceptions, have nothing that can be called a mouth, and do not feed when in the Fly-state; the maggots feed within the hide, or in the viscera, or some parts of the internal cavities of the animals, and are without distinct head or mouth; the chrysalids are formed by the maggot-skin contracting and hardening, and forming a case for the Fly within, just as happens with the maggots of Beet, or Onion, or Cabbage-root, or many other Flies.

With regard to this terse, not to say somewhat vulgar, word “Bot,” which is given to the maggots, from which the Bot Flies take their name, we seem here to have just the same word which is made use of by German

writers; there the barrel or tun-shaped chrysalids are known scientifically as tun or "tonne" pupæ, and, if you look at the barrel or butt-like shape of these Bot Fly maggots, especially when they are hooped round with their dark rings, it suggests that here we have similarly, and with a very slight alteration of the word, barrel or butt, or "Bot" maggots (see pp. 11 and 20).

However this may be, the idea will serve to keep the two great distinctions between the "Gad Flies" and the "Bot Flies" clearly before us.

The family of the *Æstridæ*, or Bot Flies, may be described for common purposes as consisting of good-sized hairy Flies, varying from about three-quarters of an inch to over an inch in the spread of their wings. The abdomen is often gaily banded with black and white, and yellow or orange-red. The Common Bot Fly of the horse is sometimes known as the "Horse Bee," and altogether, from the hairs and colouring, many of them are not unlike a light-made Humble Bee, excepting in the horns being very short, the wing-nerves few; and also in the female being sometimes distinguishable by the prolonged end of the tail, furnished with a tube for egg-laying, which can be (at least in the case of the Rein-deer Bot Fly) lengthened or drawn in at pleasure.

These Flies have, with few exceptions, the mouth obsolete, a marked distinction; and, as far as I can gather, whether their life in Fly-state is reckoned by hours or may include the active time at the beginning and end of the hybernation of the winter months in this Fly-state, they take no food.

The Bot Flies are divided, according to their habits in the larval or maggot-state, into three main sections, namely, the *Gastric*, which feed within the stomach, of which the maggots of the Great Horse Bot Fly, *Æstrus* (*Gastrophilus*) *Equi*, may be taken as an example; the *Cutaneous*, of which the maggots of the Ox Bot Fly, *Æstrus* (*Hypoderma*) *bovis*, feeding within the tumour-like swelling on the back or sides of our cattle, is a well-known instance; and thirdly, what are sometimes called

the *Cervical*, but which might better be called the *Face* or *Nostril-and-Throat* Flies, of which the Sheep Nostril-Fly, *Æstrus* (*Cephalemyia*) *ovis*, is amongst our regular sheep pests.

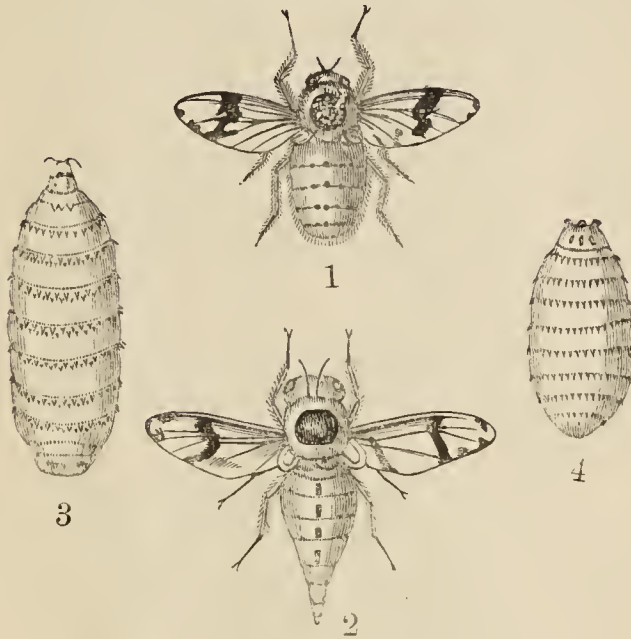
But in whatever part of the body, be it of our animals (or possibly of ourselves), these various maggots may feed, they are for the most part thick, fleshy, legless grubs, furnished with minute tubercles or spines, often set in rings round them; and it appears that they have little, if anything, like a regular form of mouth, but rather an opening more or less furnished with tubercles, which serves for the entrance of the fluid on which they feed, and in some instances the mouth-opening of the maggots is furnished with a pair of hooks, by which they attach themselves to the surface on which they feed. When full-fed they leave their position, and fall or make their way from the nostrils, hide, or whatever it may be, in or on the animal, and, like many of our crop maggots, they seek a shelter in the earth, or under a stone, or in some convenient place, where they rest while the maggot-skin contracts and hardens into a chrysalis-case, from which presently the Fly appears.

It is laid down that for the most part each species of this family of the *Æstridæ* only attacks some one species of animal, for instance, that there are Bot Flies which attack horses, or cattle, or sheep, or deer, or goats, or many other animals, but that with few exceptions each kind of Bot Fly limits its attack to what we may call its own animal, and likewise to its own special portion of it.

The *Æstridæ* are stated to be found in all parts of the world excepting New Holland, where, up to 1863, the date of the notes by Brauer, from which I quote, they appear not to have been observed. But, without going into discussions on the different kinds which occur in different countries, it is well worth while to notice that difference of climate cannot be trusted to as a means of destroying them, and this is most particularly the case with regard to two of the commonest kinds that infest the horse. The larvæ travel within the living host, and

are thus safely transferred to distant lands, there to continue their species to our future disservice.

HORSE BOT FLY.



HORSE BOT FLY.

1, male ; 2, female ; 3, maggot ; 4, chrysalis.

If we look now at the various kinds of *Æstridæ*, or Bot Flies, which are troublesome in this country, we find amongst them a genus named *Gastrophilus* from infesting the stomach or viscera, of which certainly three (and possibly more) kinds attack the horse.

One of the most thoroughly observed of these is the *Gastrophilus Equi*, formerly the *Æstrus Equi*, which is sometimes popularly known as the "Horse Bee," more exactly as the Great Spotted Horse Bot Fly, or Knee Bot Fly.

The Fly is yellowish brown, with yellowish or whitish hairs, a band of black hairs across the fore body, and blackish spots on the abdomen. The wings are opaque-white, with a transverse brownish or black band, and two spots at the tip. The female has the end of the abdomen lengthened and curved beneath her. These Flies are to be found from June until October (especially on

hill-tops), and commonly fly high on sunny days and in warm sunny weather; the process of egg-laying may be seen going forwards on horses feeding on commons or in the fields, but it is stated *never* to take place on animals when in the stable.

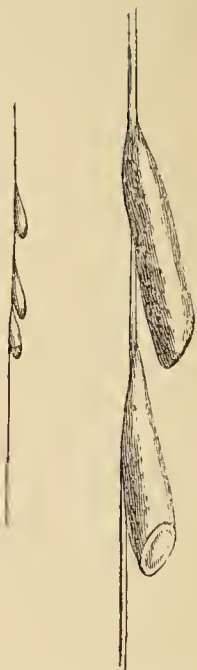
The female "Horse Bee" hovers for some little time by the animal until she has made up her mind exactly where the egg is to be laid; then, darting down on the spot, she leaves the egg fixed to the hair by means of a kind of glutinous moisture; and so she continues until her whole stock is laid.

The inside of the knee, the shoulders, and the hair of the mane are especially favourite places for egg-laying, and as many as four or five hundred are stated to be laid on one horse.

The eggs are only about the eighth of an inch in length, and are less in width, white, and spindle-shaped, or rather they are pointed at one end, and truncated obliquely at the other, and are fastened by the small end to the hair, the truncated end being lowest. In about five days (it is stated) they are ready to hatch, and then, if the horse (or another horse) licks the spot, the effect of the warmth and the moisture of the tongue causes the egg to be thrown open, and the maggot, which is produced from within, adheres to the tongue, and is thus conveyed into the mouth, and passes on to the stomach, where it establishes itself.

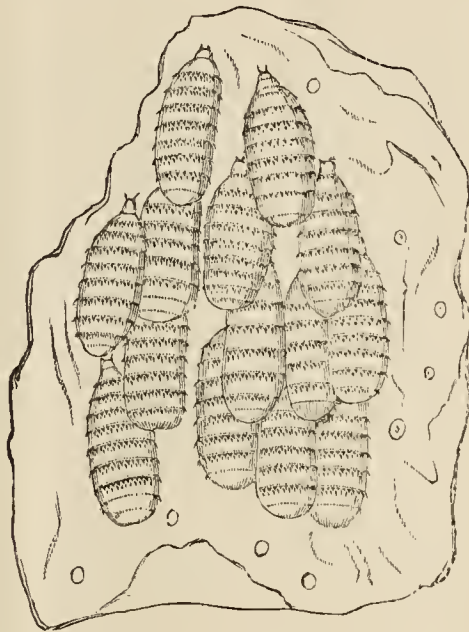
From other published observations it appears likely, if not quite proved, that where the maggots are not thus transported into the animal that they creep from the egg and drag themselves through the hair till they enter (or are licked into) the mouth.

But in whatever way they may arrive, when there they attach themselves to the stomach, where they hang



Eggs of Horse Bot Fly, nat. size and mag.

themselves in thick clusters by means of two dark brown hooks, one of which is placed on each side of the slit or opening which serves the larva or Bot for a mouth. These hooks are movable at the will of the maggot, and are found in various kinds, if not all, of those of the Bot Fly maggots that live *attached* to mucous membrane, or membrane of the internal cavities,—stomach, nostrils, &c.,—but are not in those of the Ox Bot Fly or Warble Fly (as we may more precisely call it), which live free of attachment within the skin.



Maggots of Horse Bot Fly (partly grown) attached to membrane of stomach.

The commonest kind of internal horse maggots, those of the *Gastrophilus Equi*, are of a whitish red, about an inch long when full grown, of the somewhat barrel-like shape, figured, and surrounded with double rows of horny points.

These are considered to require twelve months fully to complete their growth, and this period may be stated in a general way to last from one summer until the next. When this time is completed the maggot looses its hold, and, passing onwards with the food along the intestines, is thus (in the case of the kind we are now considering) completely got rid of. The maggot then seeks a shelter

on or in the ground, or in the rejectamenta with which it has been removed, and *there* it turns to a chrysalis,—a very important point to notice with regard to methods of prevention.

The change to the chrysalis, as with very many of the crop flies which we have often spoken of, the Mangold Fly for example, takes place by the maggot-skin hardening and drawing up into a barrel-shaped red-brown husk, within which the Fly developes, and from which it comes out after a period of a few weeks; rather less than six weeks is the longest time I see mentioned in ordinary circumstances.

This is a short history of the Great Horse Bot Fly through all its stages: now, looking at its likings and dislikings (for practical use), we find it noticed to have such a strong preference for sunshine, warmth, and open air, and such an aversion to cold and presence of water, that I give the passage from Bracy Clark's essay on the subject with little abridgement. He says:—"The perfect Fly but ill sustains the changes of weather, and cold and moisture to any considerable degree would probably prove fatal to it.

"It is remarkable that these Flies never pursue the horse into the water. This aversion, I imagine, arises from the chilliness of that element, which is probably felt more exquisitely by them from the high temperature they had been exposed to during their larval state in the body of the animal.

"This change, if suddenly applied, would be fatal to them, but they are prepared for it by suffering its first effects in the quiescent and less sensible state of a chrysalis; I have often seen the Fly during the night time and in cold weather fold itself up with the head and tail nearly in contact, and lying apparently in a torpid state through the middle of the summer." *

From these points, added to the observations previously given, that "the female only lays on horses out of doors,

* 'Essay on the Bots of Horses and other Animals,' by Bracy Clark, F.L.S., pp. 28, 29.

not in the stable," it would appear attack might be much lessened if for one thing the working horses were sheltered, during their rest hour in summer, from the bright midday heat, and similarly (if at grass) had opportunity given them of sheltering in the shade, and comparative coolness of open sheds or groups of trees; or again, had access to water, which appears, from the testimony of English, German, and American writers, an unfailing resource in attack of several kinds of Bot Flies.

The point that the maggot goes through its changes either in the manure in which it was deposited or the ground beneath it, is a most important consideration with regard to prevention; but I need not point out, with maggots of such a visible size, that to know where they are (if present at all) in the field, or yard, or stable, is to have the opportunity of collecting them, or of preventing their development by agricultural measures, which without any specification will occur to all of us.

Relatively to destroying the eggs, as these are visible on the hair of all horses excepting those of their own whitish colour, the applications of brushing, and all other measures calculated to keep the coat in order, would seem all that is needed. I am offering the suggestions of means of prevention under submission to those who understand the management of the attacked animals better than myself, but from the entomological standpoint, from the habits, that is, of the insect, it certainly appears to me that with large numbers of the horses which are necessarily passed under the hand daily in harnessing, a little care to free them from the eggs, and to shelter them or allow them to shelter themselves from egg-laying, would make a great difference, and that the same care would pay if bestowed on young or valuable animals in the fields. In days not very long ago even our best observers considered this maggot attack beneficial than otherwise; therefore it may be just remarked that to have dozens or scores affixed to the coats of the stomach, or piercing holes nearly as large as the top of a pencil deeply into it, can hardly be

conducive to health; and we have proof of this in the deaths of attacked animals from consequent internal inflammation. But here I am on points outside my own department. I have mainly entered on the life-history of this special attack for the sake of comparison with the less studied history of the kind I am now going on to.

WARBLE FLY OR OX BOT FLY.



OX WARBLE FLY.

The attacks of the Ox Bot Fly or Warble Fly, the *Oestrus (Hypoderma) bovis*, DeGeer, may be taken scientifically as a good example of the division of the Bot Flies that infest the hide. Practically and financially the subject is of enormous importance, not only on account of the suffering and waste of forces of the cattle caused by the attack, but also from the direct loss in value of warbled hides. In a letter (published in December, 1880) by Mr. W. H. Liddell, who is well qualified to express an opinion on this subject, he observes:—"There are at present, I may safely say, three-fourths of all our cattle being tortured by this inveterate insect, which, by a little trouble and at a nominal expense, could be extirpated; and thus we should save an immense amount of capital and wipe out a disgrace to all who neglect their cattle."

From experiments and information sent in during this year it appears to me that the attack might be put an end to, and any damage to the hide (save what would soon heal durably and reliably) might be escaped by the simple plan of dressing each of these maggot-infested

swellings, known as Warbles, with a little mercurial ointment *as soon as ever it is perceptible to touch and the opening has formed*, thus destroying the maggot within whilst the sore is *beginning*, instead of after it has been established several months; but it will be desirable to consider the whole of the attack, and especially the reason why the maggot-cavity does not unite thoroughly (even though it apparently heals) if left till February or March.

This Ox Bot Fly is about the same size, or rather larger than, the previously-mentioned Bot Fly of the horse. It has a hairy body and large head, with yellow face. The fore body has four raised lines along it, and the abdomen is white or yellowish towards the base, black in the middle, and orange at the end. The legs are black, with red feet, and the wings are brownish and unspotted, and with two large alulets.

The duration of the attack is from one summer to another. It may begin in May or June, or later, according to whether the cattle are in low ground or on hills, and according to other circumstances of weather, &c., but from one summer to another gives the best general idea of its whole duration.

The egg is of an oval shape and white, with a small brownish lump-like appendage at one end. There has been much scientific discussion whether the egg is laid on the cattle or inserted into the skin: it does not seem proved either way; but the most recent observations point to it being placed externally either on the skin or on the hair, and, in the case of the nearly-allied Warble Fly of the reindeer, the female Fly has been distinctly seen with the egg at the end of the ovipositor in the act of placing it on the animal. The common idea that the wild gallop of the herd when attack is going on is caused by the intense pain of the hide being pierced is not well founded, for various reasons to be referred to presently.

The warble-maggot, in the early part of its life, is white and transparent and smooth. It makes its way into the lowest parts of the skin, and lies there harm-

lessly until its first moult, when the injurious part of its life begins. Then it gains a skin beset with groups or small bands of excessively minute prickles, and by the pressure of this rough surface irritation and ulceration are caused, and swelling, and the bursting of an orifice in the warble, follows. This is the stage to which I wish more than all others to direct your attention, for, whatever we may do before or after, if we could destroy the maggot at the *first bursting* of the warble, we should save, I believe I may say all, further trouble and loss.

The grub is then to be found in the state in which it is best known; it lies with the tail-end, which is furnished with two dark horny spiracles or breathing-pores (sometimes mistaken for the head), nearest the opening, so as to enable it to draw in supplies of air. The mouth-end, which cannot be called the head, lies towards the bottom of the cell, and when I have held one of these maggots in my hand a regular contraction and expansion of the tubercles by the mouth opening was very noticeable, and as this movement also kept the bunches of prickles near in constant motion, it must have acted as a perpetual irritant in the cavity.

With the growth of the maggot it gains a deeper colour, until it is dark grey or almost black, with the patches or shagreening of minute prickles showing fairly plainly; the sac or cavity enlarges, and towards the May or early summer of the year after the egg was laid, when the maggot is come to its full growth, it presses itself out through the opening of the warble, and, falling to the ground, finds some place, as beneath a stone or in the turf, suitable for it to turn to chrysalis in, and there it changes to the perfect Fly. Occasionally (though I am not aware the exception has been brought forward before) the change to the chrysalis state takes place in the warble.

The chrysalis is dark brown or black, and very much like the maggot in appearance; and, like that of many other kinds of Flies, it consists externally merely of the maggot-skin, which has contracted and hardened so as

to form a case for the developing Fly within. But it differs a little in form from the maggot in being almost flat below.



Chrysalis of Ox Warble Fly, side view, and shewing contained Fly.

The chrysalis state lasts in common circumstances from twenty to thirty days, but is very much lengthened by cold weather, especially severe night-chills.

If we look now for the main points of the history of the Ox Warble Fly, which are to be considered regarding methods of prevention or remedy, we find the following:—

1. *The egg is laid on or in the cattle.* We need to find how to secure, or allow the cattle to secure themselves from having the eggs laid on them; and also whether there is any method of treatment by which the egg, if laid, can be removed, or the young grub killed.

2. When the maggot has established itself in the hide, *how early in its life*, and by what measures we may most certainly and easily destroy it at a paying rate, without doubt as to the soundness of the work, or pain or risk to the cattle.

3. Considerations as to *what changes occur in the surface of the warble-cell*, relatively to the importance pecuniarily of getting rid of the maggot before the new skin forms over *most of the surface of the cavity*, which prevents subsequent healing taking place.

On some of these points we have gained information from experiments made this year, and on some we may gather much of which we need by comparing published and contributed observations, amongst them some very

serviceable observations by writers well acquainted with the subject, published in the 'Leather Trades' Circular' in 1877-78.

Firstly, about *preventing egg-laying*. As a rule the *Æstridæ*, that is to say the Bot Flies, are chiefly on the wing at noontide on sunny days; it would therefore appear highly desirable that as far as possible cattle should have the means of sheltering amongst trees or bushes, where there would be some degree of shade, coolness, and moisture, which the Warble Fly dislikes. In the case of valuable milch cattle and young animals it would be well worth while to provide them with the access to sheds (now sometimes given as a preventive for attack) on a larger scale, and in a great many more instances than is at present done. It will often be found that one herd is badly attacked, and another near not at all, without the owner knowing why; but there is clear proof that an animal that is tethered so that it *cannot get from* the Flies is more liable to attack.

The shelter is not only needed for protection from egg-laying, but also to save the cattle from the intense terror which, when Fly-attack is about, sends them at a persistent trot or headlong gallop, and to their own great injury, in every direction. I think that in this matter, bad as the Bot Fly is, it bears a double share of blame, for here—that is in this one point of irritating the cattle to a gallop—the blood-sucking Gad Fly bears a part also. I have good observation of it being then detached from the brisket of the animal. But all writers agree that the Bot Fly does not go over water; therefore, in this point of view, the trampled shallow watery spots, which one can scarcely call pools, in which the headlong pace may be seen brought to an end, are of much service.

With regard to prevention of egg-laying or destruction of the hatching maggot by treatment of the coat of the animal, there are many appliances calculated to protect the coat, and also to render it as unserviceable for egg-laying on as we might say a gravel path would be to a Flesh Fly. Soft-soap and black sulphur mixed in grease,

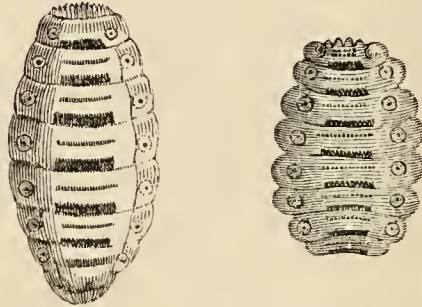
alum dissolved in water, pickling brine applied as a wash to the back two or three times in the season, quassia in water, guano as a wash, or mixed with clay and water, have all been well recommended. A mixture of flour of sulphur with a very small quantity of spirits of tar in train-oil, applied once a week with a small brush along the animal's back, has been found to answer well. The smell drives off the Flies, and the animals are left in peace.

Anything that will make the coat unfit for laying on, without hurting the animal, will serve the purpose, and the stronger and more repulsive the smell the better; but the great difficulty throughout is to get deterrents *used*. The matter (as far as I know it) is much too little thought of until the egg-laying has begun. Say or do what we will I believe an enormous proportion of the cattle will not have the least thing done for their protection from attack, and therefore the next point is what I desire most especially to draw your attention to.

We want to know *how early in its life* we can get access to the maggot *in the warble*, so as to destroy it *before* it has caused months of suffering and injury to the cattle, and also permanent damage to the hide. We know well that in the late winter or spring months the warble is noticeable as a swelling, with an opening through which the maggot may be squeezed out, or it may be pricked, stabbed, or poisoned,—destroyed, in short, in many ways in the warble,—and, so far as it goes, this is eminently desirable to do, for each maggot killed before it turns to a Fly prevents a future family; but besides, it is wanted to be known, or, if known, to be brought forward, what time (how early in the winter or previous autumn) the *first swelling and ulceration and consequent bursting* of the skin of the warble takes place, which gives us means of easily killing the young maggot within.

Up to this time, according to the anatomical investigation published by Dr. Friedrich Brauer, the maggots of this genus of Bot Flies lie completely free in the sub-

cutaneous tissues and skin-muscles, and are not contained in any capsular formation ; no opening was found over the maggot in this stage, and no thickening of the tissues, nor any exudation near it. But after this first moult the conditions of the maggot and its surroundings change, "the larva in its second stage is thickly beset with groups of prickles, which soon irritate the surrounding parts ; the tissue of the hide is disturbed, thickens, and shows that a foreign substance is present. New formations of tissue take place, and the maggot becomes enclosed in a sac, and, from the continued irritation, ulceration is set up, and the weakest part of the skin is burst through into an orifice." *



Maggots of Ox Warble Fly ; full-grown, and about to change to chrysalis,

In Germany this first bursting of the warble has been found to take place in the late summer or early autumn, and I know no reason why it should happen otherwise here ; but this is *the* point of all others that we want information on.

Sometimes attention may be drawn to this condition by the cow beginning to try to lick the spot, and about a fortnight after this, on passing the hand carefully along the back and loins, a swelling may be perceived about the size of a nut.

In a note published by Mr. Liddell, in July, 1877, he draws attention to the great relief that would result from having the maggots got rid of during or before the winter,

* 'Monographie der Œstriden,' von Friedrich Brauer, Wien, 1863.

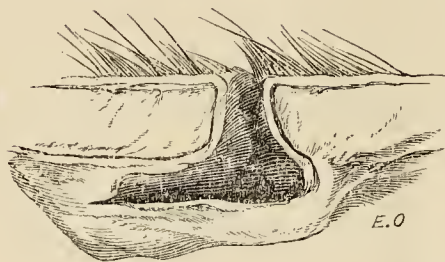
and I would submit that for those whose herds are usually infested to have them, or some of the cattle examined, say once a fortnight from September onwards, until the coming warble is felt, would be very desirable. Then, when we find the date of the first opening, the cure of the attack lies in our own hands.

During experiments recently tried by Mr. R. Stratton, of The Duffryn, on developed warbles, he found that the effect of placing a very small quantity of mercurial ointment on the opening of the warble not only killed the maggot within, but that in a couple of days after it was decomposed. This cheap and easy application, or many others, would probably act just as well on the young as the old maggot; and, if we can get to know generally when the pest first lies in our power, we can not only save the injury to the health, but the loss on the warbled hide.

At first there is only a small sore, but *after the winter* we have to deal with a perforated hide and a maggot-cell spreading as much as an inch in length in the thin tissues beneath the firm part and just above the flesh.

The real amount of damage cannot be appreciated until the portion of infested hide is examined after being taken from the animal. Then we can see firstly, in the soft under side, a swelling about as large—we may say generally—as half a walnut: this is caused by the pressure of the maggot within. On making a clean section of this we find an upright perforation through the hide, about the eighth of an inch across at the top, gradually increasing until, when it has passed through the firm parts, it bends in its course, and forms an irregular bag, wide enough for the accommodation of the maggot, and, as I said just now, about an inch long, in the subcutaneous tissues. In the cell the maggot lies slantwise, with its tail-end (containing the breathing apparatus) at the orifice above and the head below. In those which I examined, though the upper part of the cavity was healed over the surfaces, the maggot was still keeping up a sore and a flow of ulcerated matter at the further extremity by fairly grubbing and sucking at the living

tissues. I found a definite spot where this was going on, and, on holding the live maggot in my fingers, I noticed a regular expansion and contraction by which the tubercles by the mouth and the patches of minute



Section of Warble, slightly larger than life.*

prickles round it were kept in perpetual action, and apparently as perpetual irritants at this spot. The fact of a large part of the cavity being skinned over before the maggot leaves it is very obvious on examination; and for considerations as to the precise cuticle or epithelium, and the under-coating of newly-formed tissue of blood vessels, fat molecules, and other growths of the nature of true skin which form over the healing surfaces, I refer you to the anatomical investigations of the subject given by Friedrich Brauer.

These points are of interest as showing why, though when the maggot is gone, the walls of the cell may draw together, there is good reason not to expect the already skinned over surfaces will form solid union.

The specimen of leather which I hold up before you has about twenty-four holes caused by the Warble maggot in a length of 12 in. by 3 in.; this other piece has about seventeen holes in nearly the same measurement; and, if you multiply this by the extent of skin often attacked on the back and loins of the cattle, and by the large percentage of the cattle that are thus attacked, it will be obvious that the evil calls for serious attention.

* The above figure was taken from a warble that had been soaked for about a fortnight in brine, and shows the growth of firm skin on each side of the section of the upper portion of the cavity, and also the large size of the sac formed in the lowest tissue of the hide, as seen when the hide is removed from the infested animal.

We have not (as far as I am aware) any estimates as yet of the yearly pecuniary damage from this cause, but I have a note from one of the West Country hide firms of loss in value of warbled hides being from 10s. to 15s. apiece ; and in the recent discussion on the subject at the Royal Agricultural Society, Mr. Stratton gave it as his opinion that from various causes, including injury to health, milk, &c., there was a loss of £1 per head per annum on the cattle of this country through the injuries inflicted by this Warble Fly.

It is not for me to venture to offer an opinion on many of the details of treatment advised by those who know far more of the points of direct treatment of the cattle than I possibly can do ; but this I may say, from my own standpoint of entomological research, that if the treatment and attention advocated years ago by Mr. Liddell, and also shown by Mr. Stratton to be perfectly successful, were carried out, the attacks would be at once greatly *shortened in the period* in which they cause injury to the animals, *lessened in injury* to the hides, and likewise the absolute number of Flies would be *greatly diminished*.

The enquiries of the last few months have shown how much sound practical knowledge on this subject exists in the country, which would be of exceeding use if collected and published ; likewise how much invaluable *common sense* practical advice has been given as to the importance of cattle owners not only fully knowing what to do, but also *doing* what lies in their power to diminish this destructive attack ; and I trust I shall not be considered to venture beyond my own exact department in mentioning that, whilst in obedience to the request of the Royal Agricultural Society as their entomologist I am endeavouring to procure all serviceable information on the habits of this destructive cattle fly, I shall feel greatly indebted to all who will be so good as to favour me with notes bearing practically on the subject for publication as a separate report.

For further information on the specific distinctions of the Flies, the peculiarities of habits, or anatomical structure of the Warble skin, I refer the reader to the works which I have mainly quoted from above, namely—

‘Essay on the Bots of Horses and other Animals,’ by Bracy Clark, F.L.S.

‘Monographie der *Æstriden*,’ von Friedrich Brauer.

‘Praktische Insekten Kunde,’ von Dr. E. L. Taschenberg.

I have also to express my thanks for the assistance kindly given me by furnishing specimens, all which will be fully acknowledged in the report on this subject.

E. A. O.

The figures of the Horse Bot Fly in its different stages (at pp. 9, 10, and 11), and those of the Ox Warble Fly (at pp. 14, 17, and 20), are copied from the illustrations given by Bracy Clark in his ‘Essay’ before quoted.

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